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BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

TIMBER MANAGEMENT HAND BOOK OF REGION 4 AND INSECT CONTROL POLICY OF REGION 4

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PART X - INSECT CONTROL

References.

"Correspondence Course on Forest Insects" by J. C. Evenden. On file at all forest headquarters.

"Insect Enemies of Western Forests" by F. P. Keen, Misc. Publication No. 273.

"The Black Hills Beetle a Serious Enemy of Rocky Mountain Pines" by J. A. Beal, U. S. Government Printing Office.

In lieu of other references, requests for information can be sent to the Forest Insect Laboratories, Coeur d'Alene, Idaho, and Fort Collins, Colorado.

Attention of
Evenden
Keen
Gibson
Rust
Terrell
English

Policy.

Forest insects are now generally recognized as an important agency of destruction to forest crops and products. With this recognition have come more liberal appropriations for forest entomological work, and it now seems entirely possible to place the task of insect control on a much-desired, systematic basis. The policy expressed in the following statement is for the guidance of forest officers in meeting the requirements of this Region relative to its forest insect problems. In formulating this policy an attempt has been made to keep it sufficiently flexible to include the many variable problems which will occur and still avoid confusion in the procedure to be followed.

Though epidemics of certain insects can be economically reduced through the application of direct control, outbreaks of other species cannot be economically combatted with methods available under our present knowledge. In the first group are included practically all species of tree-killing bark beetles, while cone and seed insects, tip moths, aphids, and many other injurious species are listed in the second classification. Though defoliating insects such as the spruce budworm, pine butterfly, etc., can be destroyed with stomach poisons or contact sprays, the treatment of large forested areas is generally prohibitive. The control of such insects will naturally be confined to small areas containing trees of high scenic values around resorts, summer homes, campgrounds, etc. As a rule the trees located in such areas will doubtless receive more intensive care than those in other areas.

In eliminating excessive timber losses resulting from bark-beetle attack, the first requirement is an organized and adequate system for the detection of outbreaks in their early stages, to be followed by prompt

control measures when and where needed. Such information will permit the institution of artificial control at a time when it is most effective and least expensive. To meet this requirement within this Region a definite system of well-planned insect surveys will be instituted. These surveys will not supplant the insect status reports submitted annually by all forest rangers, but will be directed to areas where existing conditions warrant the securing of detailed information necessary in determining the need for control. The rangers' "Insect Status Reports" have been of invaluable service in the past, and must continue to serve as initial reports of all forest insect infestations throughout the Region, indicating the need for more detailed examinations by specialists of the Forest Insect Laboratories of Coeur d'Alene, Idaho, or Fort Collins, Colorado, as well as subsequent surveys leading to the institution of control.

In this Region the mountain pine beetle (Dendroctonus monticolae Hopk.) and Black Hills beetle (Dendroctonus ponderosae) epidemics in lodgepole pine and ponderosa pine have resulted in the greatest losses of commercial timber. However, outbreaks of the western pine beetle (Dendroctonus brevicomis Lec.) and the southwestern pine beetle (Dendroctonus barberi) in ponderosa pine and the Douglas fir beetle (Dendroctonus pseudotsugae Hopk.) in Douglas fir are at times responsible for severe losses. Mountain pine beetle infestations in whitebark pine destroy watershed values; the Engelmann spruce beetle (Dendroctonus engelmanni Hopk.) often reaches epidemic proportions in spruce; the red turpentine beetle (Dendroctonus valens Lec.) attacks the bases of ponderosa pine, making them attractive to the attacks of other insects; and there are many other species of economic importance in the growing of forest trees. Species of so-called secondary bark beetles will, under conditions favorable for their multiplication, become primary killers and destroy healthy trees. The activity of all destructive forest insects should be included in the annual insect status report, for even though no measures of control might be available, the information will serve to keep regional officers advised as to the existence and importance of such outbreaks.

Physical changes in forested areas often result in conditions favorable to the development of subsequent bark-beetle epidemics. Such abnormal forest conditions as fire-scorched trees, areas of windthrown timber, cull logs, road slash, defoliation by insects, or departures from customary logging operations often create situations favorable to the rapid increase of bark-beetle populations. Though the importance of each situation arising from these conditions must be evaluated on its own merits, their potential seriousness warrants thorough consideration in order to avoid unwarranted losses.

For the purpose of simplifying this statement, it is considered advisable to break the following discussion into different timber types. This discussion will include only those injurious insects for which practical methods of control are available.

Ponderosa Pine

Losses of both mature ponderosa pine and reproduction occur from the attacks of the mountain pine beetle, the western pine beetle, the Black Hills beetle and the southwestern pine beetle, and such secondary insects as Ips oregoni, Pityogenes knechteli, etc.

In this Region losses of ponderosa pine resulting from attacks of the mountain pine beetle have usually occurred when such timber stands were adjacent to heavily infested lodgepole pine areas, though the possibility of local outbreaks developing should be recognized. Such infestations as have occurred died out with the cessation of the mountain pine beetle epidemic in lodgepole pine. However, infestations of the mountain pine beetle in ponderosa pine should be observed closely and existing circumstances promptly reported.

Outbreaks of the Black Hills beetle build up in ponderosa pine, limber pine or lodgepole pine and because of the aggressiveness of this insect and the speed with which it is possible for it to increase to epidemic proportions, any areas where it occurs should be carefully watched and conditions thereon promptly reported.

There is in all mature ponderosa pine stands of the northern part of the Region a so-called normal infestation of the western pine beetle. These normal infestations fluctuate annually. Though in the ponderosa pine forests of the Region there have been no serious outbreaks of this insect comparable to those which have occurred on the Pacific Coast, the importance of infestations of this insect should not be minimized, as a thorough examination will often show that the annual loss of timber is greater than anticipated. As there are two generations of the western pine beetle each year, normal infestations materialize into potentially serious epidemics in a short period of time. To prevent such an occurrence all infestations should be reported with sufficient detail to permit a decision as to the subsequent action necessary.

Cull logs, broken chunks of trees, road slash, and fire-scorched or defoliated areas of ponderosa pine are readily attacked by the western pine beetle, though the subsequent emergence from down material is usually much less than from standing infested trees. However, the danger from accumulations of this material should not be minimized for by attracting insects to the area it can be a big factor in increasing subsequent infestations in adjacent timber stands. The peeling of uninfested debris to prevent attacks of this insect is an expensive procedure, as a large percentage of the material treated would perhaps never be infested. When necessary, accumulations of ponderosa pine logs will be treated, but only infested material will be treated. Accumulations of ponderosa pine slash should be kept under careful observations, and if attacked by the western pine beetle, mountain pine beetle, or any other primary insect, the situation should be reported promptly. When the seriousness of the situation warrants, an intensive examination will be made by officers of the Forest Insect Laboratories to determine the seriousness of the situation and the need for treatment.

In addition to attacks by the western pine beetle, all abnormal accumulations of ponderosa pine slash, regardless of size, are nearly always heavily attacked by such secondary bark beetles as Ips oregoni, Pityogenes knechteli, etc. Extremely heavy broods result from these attacks, and upon emergence, if an additional supply of freshly created slash is not available, the insects will often attack and kill adjacent trees. In some instances fresh accumulations of slash act as an attraction only, and the beetles which are drawn to the area make their initial attacks on standing trees. A series of exceedingly dry seasons will often result in spot killing by these beetles. Though at times forest sanitation practices can be employed for the purpose of preventing such conditions, it is gratifying to know that when they do occur the outbreaks last for only one, or possibly two seasons. However, abnormal accumulations of ponderosa pine slash which are infested by bark beetles should be reported. As the identity of the insects often determines the seriousness of such situations, specimens of the beetles as well as samples of their work should be submitted for identification in all doubtful cases. These data will serve to depict the seriousness of the reported situation as well as the need for a more intensive examination by forest entomologists.

Lodgepole Pine

Though serious losses of lodgepole pine are associated with epidemics of the mountain pine beetle or Black Hills beetle, the damage resulting from normal infestations is negligible. During normal infestations the attacks of these insects are confined to windfalls or valueless trees which have been badly weakened and are in a decadent condition. Though the resulting timber loss may be of no moment, such normal conditions should not be dismissed as situations of no importance. The Region is concerned with the prevention of bark-beetle epidemics, and the devastated lodgepole forests of Idaho remain as evidence of the importance of this problem.

Epidemics develop from normal infestations within areas where conditions have been made favorable for the increase of the insects as a result of some change in environmental conditions. It is also true that when an epidemic has developed, the infestation may spread for miles through adjacent lodgepole pine stands. Any abnormal or new infestation of bark beetles in lodgepole pine should be reported in sufficient detail to permit a decision as to future steps necessary. Within those forests which in the past decade or more have experienced a severe epidemic of the bark beetles there will be but little likelihood of a recurrence of this condition for a period of years, due to the shortage of host material. However, in those forests, or portions of forests, which escaped this destruction extreme precaution should be exercised. Intensive surveys of lodgepole pine forests will for the most part be confined to those areas where alarming conditions have been reported or are feared to exist as a result of known infestations within adjacent areas. Insect status reports will serve as the most important guide in the proper planning of surveys for lodgepole areas.

Cull logs, fire-scorched trees, or other lodgepole pine debris are not of serious importance in the building up of bark-beetle epidemics. Though these insects are attracted to such accumulations of freshly cut material, they will more often attack standing trees than the slash itself, with the exception of fire-scorched trees, which are readily attacked and often a factor in the development of subsequent outbreaks. So, though such material may result in concentrating attacks of the bark beetle, it contributes very little to an abnormal increase in the beetle population. Logs and large pieces of slash are attacked by Ips oregoni, Pityogenes knechteli, and other insects, which upon emergence will attack and destroy standing adjacent trees. Though lodgepole pine slash is not considered as being of any great importance, its potentials should not be disregarded entirely, and accumulations of such debris should be kept under observation and necessary reports submitted.

Douglas Fir

Outbreaks of the Douglas fir beetle occur from time to time within the Douglas fir stands of the Intermountain Region, with a so-called normal infestation existing in all areas of mature timber. Such normal infestations that persist in windfalls, broken tops, and decadent trees develop rapidly into rather serious outbreaks when conditions are favorable. These outbreaks may spread over rather large areas, destroying a high percentage of the timber stand, or they may be confined to small spots of an acre or more. Such infestations should be recorded at the first appearance of abnormal conditions in order that necessary subsequent action may be taken.

More intensive surveys will be directed into those areas where alarming conditions are reported, and where it would appear that the institution of control would be warranted.

Cull logs, road slash, and fire-scorched or insect-defoliated areas of Douglas fir are readily attacked by the Douglas fir beetle, and the resulting broods will, upon emergence, attack standing trees adjacent if an additional supply of more attractive host material is not available. Fire-scorched trees with areas of green cambium remaining are extremely attractive to the Douglas fir beetle. As large, healthy broods of this insect are produced from this weakened material, areas of fire-scorched Douglas fir constitute a serious menace to green timber stands adjacent. The occurrence of such situations should be recognized as sources of epidemics, with sufficient attention being devoted to them to determine the extent of the potential Douglas fir beetle infestation. The annual insect status reports should include detailed statements of all abnormal forest conditions.

EXAMINATION OF INFESTED AREAS

The actual status of a bark-beetle infestation, including the ramifications which the word "status" implies, determines the need for the institution of control. The elimination of excessive timber losses as a result of bark-beetle attack rests upon the institution of control at a time when the greatest number of insects will be destroyed for each unit of work with a minimum expenditure. An accurate depiction of an infestation which will permit an analysis as to the necessity for control requires the consideration of the following factors:

(1) Increase in the Annual Loss. Any marked increase in annual losses associated with normal infestations can be taken as a warning of pending outbreaks. However, an increase in the severity of an epidemic does not always indicate its future trend, as obviously there is a year when the peak of the infestation is reached. The most valuable data are those which indicate decided changes from normal to epidemic conditions. To check one's reaction as to the extent of such a change, a few miles of sample strip on which the number of newly attacked trees is compared to that of the previous season will provide information upon which a decision can be based.

(2) Occurrence of Infestation. The occurrence of infested trees during the different stages of insect outbreaks will vary with different timber types. However, it can be rather generally stated that during endemic infestations the infested trees occur as scattered individuals or in small groups of not more than two or three trees. The occurrence of infested trees in larger groups can nearly always be taken as indicating an epidemic condition, though in ponderosa pine extremely large groups or blocks of infested trees often mark the year of maximum loss.

(3) Condition of Insect Broods. Though a difference exists in the character of insect broods during endemic and epidemic infestations, it is not always in marked visual evidence. Though this information relative to the actual conditions of bark-beetle broods can only be determined from a detailed analysis having as its objective the establishment of a ratio of insects emerging to those attacking, the reporting officers' reaction to brood conditions is always of value. Without a great deal of time or labor it will nearly always be possible to offer one's reactions to the character or severity of the attacks.

(4) Character of Individual Trees Attacked. During endemic infestations in lodgepole pine only decadent or badly injured trees are infested, and in this timber type the

character of the trees attacked offers an index to the trend of an infestation. To a limited extent this is also true of endemic infestations in ponderosa pine and Douglas fir, though one often encounters apparently healthy trees which have been selected for attack during such infestations.

(5) Foliage Discoloration. The use of discolored foliage as indicating the status of bark-beetle broods within infested trees is confusing. The foliage of insect-attacked trees varies not only with different seasons, but there is a local variation within each area due to exposure, site, and severity of attack, which prohibits the adoption of standard foliage classifications. Discolored foliage can be used as a guide to the location of insect-attacked trees, and if a number of trees are examined, a fairly close relationship can be established between the various types of foliage discoloration and the age of attack for that particular examination. Previously constructed foliage charts have been disregarded as being of little practical service for field examinations.

In summarizing these remarks it is desired to again stress the objective as expressed in this policy, which is the prevention of epidemics rather than their control. As a result, forest officers are primarily concerned with detecting and reporting any initial change in a normal, or endemic, infestation, for after an epidemic has developed its status is of rather general knowledge to regional officers. The securing of these data is not an easy task, and it will often be necessary to run a few miles of sample strip in questionable areas. Such strip surveys need not be extensive, but should be in sufficient detail to permit the reporting officer to submit an accurate depiction of conditions.

ANNUAL REPORT ON INSECT INFESTATIONS

Annually, by October 15, a report for each forest will be forwarded to the Regional Forester showing the insect situation on the forest. It must give a clear picture of the rise or fall of any insect infestation which will enable the Regional Forester to make definite recommendations for or against control measures and make a case for the allotment of funds, if needed. It should cover:

1. Location, extent of infestation, description of area involved including types, terrain, acreage, contiguous stands of timber, and degree of isolation.

2. Species of timber involved.

3. Insect or insects responsible for damage.

4. Status of infestation - current and past losses - trees per acre or percent of stand being destroyed.

5. Recommendations for artificial control measures will be based on a consideration of the following:

(a) Are control measures entomologically sound? (Forest officers are not expected to decide this point for this is a definite function and responsibility of the Bureau of Entomology and Plant Quarantine.)

(b) Are control measures economically sound, i.e., are the values involved somewhere near comparable to the funds to be expended for control purposes? What are the potentialities of the outbreak? Consider all values such as recreational, watershed, esthetic as well as the value of the timber for forest products.

Whether or not you recommend that control measures be taken. If you recommend control measures the following should also be submitted:

6. Map showing location of projects with division into control units.

7. Insect survey report and report on previous spring control project (if any) should reach the Regional Office by the time the annual report arrives.

8. How much you can handle with contributed time and funds already allotted and how much additional money you must have.

9. Do you desire that the Regional Office secure additional supplies or equipment? If so, itemize.

10. Do you want to do the control work this fall or next spring?

INSECT SURVEYS

Better Estimates Required.

Past insect control projects have indicated unmistakably the need for adequate preliminary surveys before undertaking control jobs. There have been many wide discrepancies between forest estimates and infested trees actually found on control jobs. As a means to bring them closer together, Mr. James C. Evenden of the Bureau of Entomology and Plant Quarantine has promulgated a set of instructions for making surveys which is reproduced here and should be followed. It will be amplified to some extent regarding the nature of data to be observed and recorded in many specific projects.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

INSTRUCTIONS FOR CONDUCTING EXTENSIVE BARK BEETLE SURVEYS BY THE METHOD OF SAMPLE STRIPS

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The need for efficient performance in conducting forest insect surveys can not be overemphasized, as the data obtained determine future control activities, which may involve large expenditures of funds. It is essential, therefore, that all survey projects be planned and executed as carefully and thoroughly as possible. The following instructions are not concerned with the administration of survey crews, nor do they pretend to establish the only method of conducting bark beetle surveys. They have as their objective the description of the "sample-strip survey" as used by the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, as an effective bark beetle survey for northern Rocky Mountain timber types. Though perhaps subject to statistical and other criticisms, during the past decade or more this method has been found to be sufficiently accurate to satisfy the demands made upon it.

In the sample-strip survey a record is made of the number of infested trees on a strip projected through the area being surveyed. From these data the number of infested trees per acre of strip is calculated, and this figure is multiplied by the total acreage to obtain the number of infested trees on the whole area. Obviously the accuracy of this estimate is dependent upon a representative sample and the correct acreage of the area in question.

In sampling an area to determine the severity of a bark beetle infestation strips are more efficient than sample plots. Though these two procedures offer the same potentials, strips permit the coverage of a larger acreage and provide a more representative sample of an infestation owing to the spotted or unequal distribution of infested trees.

LOCATION OF SAMPLE STRIPS

A sample is "a part of anything presented for inspection, or shown as evidence of the quality of the whole." Strips should be located so as to provide a true sample of the area under consideration. Type maps must be carefully studied as an aid in determining these locations, as it is a task requiring the best judgment of the officer in charge, and its importance must not be minimized.

Strips along creek bottoms or tops of ridges are not indicative of average conditions. Likewise, strips run in "bug timber" only would

not produce representative data if there were areas of nonhost timber types, sagebrush, and openings to be included in the total acreage to which strip data are to be applied. Obviously the strips should contain the same proportions of the various types of areas that occur in the entire acreage. For example, with an area of 5,000 acres in which there are 900 acres (18 percent) of small reproduction and 850 acres (17 percent) of nonhost timber and sagebrush, a representative sample would show 65 percent of the strip in "bug timber" and 35 percent in nonproductive areas. Though such detailed accuracy can not always be secured, an effort must be made to obtain such representative samples.

Strip lines can assume different patterns, depending upon the shape of the area being surveyed and the character of the terrain. In large areas the most common form is a long rectangle, the two sides being separated by a strip offset of one half mile or more. With smaller areas the form may be a triangle, octagon, square, or a gridironing of the area with short strips a stated distance apart.

When large, fairly solid bodies of timber are involved the selection of strip location is a relatively simple task. With such situations strip lines are projected so as to provide representative samples of the entire acreage, including openings, and the survey data applied to the total acreage. With small patches of timber, where the acreage is small and the distance between the patches so great as to prohibit the inclusion of the entire area in the survey, the task is more difficult. Under such circumstances it is necessary to confine strip locations to the timbered acreage of each small area, or at best to connect groups of two or more of these small tracts.

Though sample-strip surveys are often considered as being somewhat mechanical, let it be emphasized again that strip locations can not be selected by prescribed rules, as each area presents an individual problem requiring an independent solution. A few rules applicable to all situations are as follows:

1. Strips must not be projected along trails, ridges, streams, or contours.

2. Strips should cross drainages either perpendicular to the course of the stream or in an oblique direction.

3. Strips may extend along section lines if the direction gives the desired location.

4. Strips may extend in cardinal directions or at stated bearings to meet the requirements of the territory being covered.

5. Strip locations should be plotted on the cruiser's field map.

6. Strip locations should avoid long off-strip or nonproductive walks. Strips can be extended in any geometric pattern best suited to the area, so that the starting point and end of the strip will be near camp or available transportation.

7. When it is necessary to avoid swamps, lakes, rock slides, cliffs, etc., right-angle offsets can be made with a return to the original course. In making offsets to avoid obstacles only the distance parallel to the original course should be recorded as the distance traveled, and all infested trees encountered on the offset should be disregarded, as obviously none would have been encountered on the original strip.

8. The length of strip which one man can cover in a day depends upon the character of the infestation and the topography of the area. Over a period of years survey crews have averaged approximately four miles of strip in white pine and nine miles in lodgepole pine. However, these figures will vary for different situations.

WIDTH OF SAMPLE STRIP

In surveying bark beetle infestations in lodgepole pine and white pine a strip one chain (66 feet) in width is all that one man can cover efficiently. This width is effective, as it permits the cruiser to follow a center line and observe all trees on the strip with a minimum of side travel. Even with strips of this width it is often necessary to leave the center line and examine trees which are on the border or are surrounded with brush. A wider strip increases side travel and materially reduces the size of the sample which one man can cover. When a survey of greater intensity is desired more strips should be added. Wider strips can be used in open stands of ponderosa pine where foliage discoloration can be used as an indication of infested trees.

COMPASS BEARINGS

Though sample strips are projected on compass bearings, the expression general compass bearing is used. Though cruisers require a compass to keep upon their prescribed course, an accurately projected compass line is not necessary. The actual bearing of a strip is the direction selected as the one which will provide the most representative sample. Though the general direction may be entirely correct, the actual bearing is but an arbitrary selection, and variations of a few degrees will provide a better sample as often as they will detract from its accuracy. Therefore, though sample strips must adhere to general compass bearings, accurate lines are unnecessary, as the lack of advantages to be gained does not warrant the time required for such close work. Long compass shots, traveling at a definite angle to shadows from tree trunks or keeping the sun in definite positions will provide a sufficiently accurate course and materially increase the acreage covered. Staff compasses are not necessary for sample strips and their use is not recommended. A small 2-1/2- or 3-inch needle box compass is sufficiently accurate and a great deal faster. When too much attention is given to compass lines, the recording of infested trees will be slighted, and the omission of a few trees will often produce a marked change in the final results.

OPERATION OR MECHANICS OF SAMPLE STRIP

The equipment required for each cruiser is a box compass, two tally registers, a light belt ax, strip-sheet forms, a tatum holder, pencils, a map of the area, and a full realization of the importance of the task. Cruisers must pace distances accurately over rough terrain, which is an ability rather easy to acquire. In learning to pace correctly one must determine how many double steps are necessary to cover a distance of 66 feet, or one chain, when walking naturally. This number will range from 11 to 13. Only horizontal distances are measured, so paces on slopes must be adjusted to conform to this requirement. This also applies to the width of strip, as when strips contour steep slopes an allowance must be made to provide for a horizontal width of 66 feet. When rough territory is traversed it is often necessary to estimate the number of double paces required to cover a short distance or to take three or even four steps for a double pace. Pacing should be checked at frequent intervals. When surveyed country is being covered the cruiser should try to check his pacing each time a section is crossed in a cardinal direction or a section line is followed.

The cruiser's paces are recorded with a tally register, an operation which soon becomes automatic. As the foot opposite the hand carrying the register strikes the ground or as the hand swings forward, the plunger is depressed, which records each double pace. As this procedure is automatic, the cruiser is permitted to devote his entire attention to his search for "bug trees", and mistakes which occur when one attempts to count paces and look for "bug trees" at the same time are eliminated. The second tally register, carried on a neck cord or in a convenient pocket, is used to record newly attacked trees.

Best results are obtained in lodgepole pine stands and other similar timber types by having the cruisers work alone. Each cruiser travels along the prescribed compass course, paces the distance, and counts the newly attacked trees on a strip one chain in width. However, in rough territory or in dense timber stands and heavy underbrush, the task of pacing and following even a general compass line is a more difficult task. In such areas it is sometimes advisable to use a two-man crew with one compass, each man covering a strip one chain in width. The primary advantage of this plan is the psychological effect of having two men working together over a difficult terrain, relieving the monotony of the work as well as providing an opportunity of changing compass responsibilities at the end of each mile.

The number of newly attacked trees is recorded on the strip sheet (page 117) for every ten chains of lineal distance covered. When these data are plotted upon a project map, the areas of heavy infestation are readily identified. When no new attacks are encountered, no record need be made, and cruisers often go for a mile or more without making an entry upon the strip sheet. When infested trees are found after traversing such an area, the nonproductive portion of the strip should be recorded and the trees allocated to the ten chains of strip where they are located.

On the strip sheet there is a column for remarks. In this space a notation should be made as to the character of the forest

being covered, i.c., sagebrush, meadows, openings, reproduction, poles, or mature timber. If different species of trees are attacked by the bark beetle the hosts should be recorded separately.

In connection with the counting of new attacks, there is often a tendency to record "red tops" (attacks of the previous year) for a comparison between the losses of the two seasons. This practice should be avoided unless the data are considered as indispensable to the project, as red tops and new attacks can not be counted in the same operation without considerable error. This error arises from the difficulty of looking in the crowns for red tops and at the base of trees for new attacks. Furthermore, red-top counts are not overly reliable, as it is often difficult to determine the year in which the trees were attacked.

At the close of the day's work each cruiser will summarize his strip sheets and turn them in to the chief of party, who will transfer the data to the Unit Summary form (page 118). Strip-sheet summaries must show total chains traveled, number of strip acres, number of new attacks recorded, and the average number of new attacks per strip acre. Any departures from the projected strip should also be recorded. By keeping field records up to date, an estimate of the number of infested trees for each unit is available as soon as the survey is completed.

ACREAGE OF AREAS SURVEYED

The method of sampling discussed in these instructions provides an index to the intensity of an infestation, or the average number of infested trees per acre. However, to obtain an estimate of the number of infested trees within a definite unit, the total acreage of the area must be available. Acreage figures must be accurate or serious errors will occur in the estimate of infested trees.

When large areas are surveyed, acreage figures can be obtained from maps with a planimeter, or fair estimates can be made by counting the number of sections or smaller blocks of a known area. With small units consisting of a part of one or two sections the task is often more difficult, especially when only small-scale maps are available. Type maps will often be available, which provide satisfactory acreage figures.

When the acreage or boundaries of small units are not known strip locations must be planned to provide data that will aid in obtaining this information. With such situations strips should be projected back and forth through the area on a zig-zag course, with a change in bearing each time the edge of the timbered area is reached. When such strip data are plotted to a fairly large scale, the boundaries of the area are shown in sufficient detail to provide a satisfactory acreage figure. In taking strip data which are to be used subsequently in constructing a map, the location of all important topographical features such as ridges, streams, trails, etc., should be shown on each line. If desired, map sheets and protractor can be carried in the field, and the course and boundaries of the areas plotted as the work progresses. Though this requires additional time, better results will be obtained, as the

boundaries of a small area can be more accurately mapped from the end of each strip than from field notes. Though all situations require individual solutions, it must be bornein mind that the survey of each unit, regardless of its size, must produce a reliable estimate of the intensity of the infestation as well as the total acreage to which strip data can be applied.

PERCENTAGE OF AREA TO BE COVERED BY SURVEY

No definite rule can be given as to the percentage of the total acreage that should be covered by sample strips, as it will depend upon the time and money available, as well as the character of the infestation involved. Spotted or scattered types of infestation will require a much larger sample than when the infested trees are equally distributed. With small areas it is necessary that from 6 to 15 percent of the total acreage be covered if accurate data are to be obtained. When large areas are involved, a smaller percentage covered provides a larger total sample, which increases the probability of obtaining a representative sample. In surveying large acreages of timber the size of the sample should not be less than 1-1/4 percent of the total acreage, which is a one-chain strip through each section. In white pine and ponderosa pine stands, where the units are usually smaller, with fewer trees per acre and a correspondingly lighter infestation, a larger (4 to 6 percent) sample is required.

LOCATING INFESTED TREES

Extensive surveys of the mountain pine beetle, Engelmann spruce beetle, Douglas fir beetle, Black Hills beetle, and southwestern pine beetle seldom revealed any fading of foliage during the same season of attack. Therefore, in locating newly attacked trees it is necessary to depend almost entirely upon pitch tubes at the mouths of entrance holes and boring dust around the base of trees and on flakes of bark. Though in most cases external signs of attack are easy to see, there are times when a close examination is necessary to determine their existence. Pitch tubes associated with heavy attacks are small or missing entirely, and boring dust is often obscured by grass or underbrush. There are no pitch tubes associated with attacks of the Douglas fir beetle. When cruisers are traveling toward the sun or working in dark timber stands, it is extremely difficult to spot external signs of attack, and extra precaution must be exercised.

All newly attacked trees are recorded. Though it is realized that some light attacks may be subsequently "pitched out", this possibility is disregarded, as the recording of such trees compensates for those which may be missed or for those attacked subsequent to the survey.

The cruiser should examine a number of infested trees each day to get some idea as to the severity of the attacks, the relative abundance of brood per unit of bark area, the height to which the infestation extends, and the average size of trees being attacked, as such information will be useful in describing the character of the infestation.

EXECUTION OF FIELD WORK

The purpose of bark beetle surveys is to collect data which will be useful in the early recognition of areas of severe infestation. If such data are to be of service, final reports must be submitted promptly and all serious or questionable situations reported as they are recorded. This objective can be met only through a careful and thorough planning of preliminary and necessary details, and in seeing that they are carried through to completion. Field data must be kept up to date so that as the survey of each unit is completed the character of the infestation will be revealed. This permits a reexamination of questionable areas and the prompt submission of a report when necessary.

Work plans for bark beetle surveys must be somewhat flexible, as the actual execution of duties involved will vary with different situations and types of survey organizations. However, there are certain duties in connection with the primary objectives of bark beetle surveys that must be carried as the work progresses. These instructions can not be considered as complete or in any way detracting from the responsibility of the officer in charge, who must be constantly alert for improving the details of execution, which will make the project of greater service.

Prior to the institution of a survey project the chief of party should obtain type maps of the forest to be surveyed, estimate the timbered acreage to be covered, and determine the number of man days which the financial allotment will provide. In determining the number of man days to be devoted to the survey the entire allotment should not be exhausted. A balance of perhaps 10 percent should be held to absorb time lost on rainy days and to provide for the check of questionable areas.

The following suggestions are applicable to all projects:

1. The number of sample strips should conform to the estimated number of man days and provide a uniform sample from each area. In new or unfamiliar areas subsequent readjustments of strip locations may be necessary.

2. In plotting sample strips consideration should be given to camp locations, with a view to a saving of travel time. Accessibility to roads should be considered.

3. Strips should be plotted so as to fall within one unit.

4. When necessary for sample strips to extend into more than one unit, they are given new numbers and new strip sheets used. As the boundaries of such units are usually of a natural or artificial nature, this is not a difficult task.

5. Regardless of the number of strips run in each unit, which may range from one to 25, the data from each strip will be entered in the Unit Summary.

6. As each unit is completed the form Unit Remarks will be executed and attached to the Unit Summary as completing that portion of the survey report.

7. When the survey of the last unit has been completed, an introduction and a summary sheet showing the cost of the project will put the report in shape for typing.

8. No employees should be permitted to run strip until they have been fully trained in the execution of the work, and every opportunity must be taken to impress upon them the importance of the task. Different methods should be employed to check the actual execution of field work, which will depend upon the situation involved.

9. Strip data must be computed accurately and recorded in a neat and standardized manner. Mistakes in simple addition are in most cases a matter of carelessness.

FORMS

The following forms are used in connection with forest insect surveys and have been found satisfactory:

Strip Sheet

Unit Summary

Unit Remarks

Map of Unit

STRIP SHEET

Beaverhead - Rattlesnake Region | 1 Sheet No. | August 6, 1938 Date

End of road - Tent Lake Starting Point

Bill Brown Signature

Bearing	Chains	N.A.	Remarks
N 45° W	1 - 40	0	Poor bug timber
	41 - 50	1	Light attack
	51 - 120	0	
	121 - 130	4	Small trees
	131 - 160	0	
East	1 - 100	0	
	101 - 110	3	1 heavy attack - heavy brood
	111 - 190	0	
	191 - 200	1	Good bug tree
	201 - 280	0	Poor scrubby timber
S 45° W	1 - 60	0	
	61 - 70	2	Good bug trees
	71 - 180	0	
Chains	- 620		
Acres	- 62		
New attacks	- 11		
New attacks per strip acre -		.17	

UNIT SUMMARY

Rattlesnake Unit Beaverhead Forest

Timbered acres to which strip data are to be applied 26.04 Acres

1938	Strip Number	Chains of Strip	Acres of Strip	Trees on Strip: New Attacks	Trees on Strip: (x)	New Attacks per Strip Acre (xx)	Remarks
Aug. 5	1	740	74	27		.36	
"	2	720	72	29		.40	
"	3	720	72	35		.48	
"	4	800	80	28		.35	
Aug. 6	5	760	76	37		.48	
"	6	620	62	15		.24	
"	7	620	62	11		.17	
		(Should be space for about 15 strip lines.)					
Totals		4,980	498	182			

Average number infested trees per strip acre ..... .365
(Total number infested trees countded divided by total acres covered.)

Estimated number of infested trees on unit 9,507

(x) This column can be used for counting red tops for a comparison of losses, if considered essential, or for green trees on strip if one desires to know the percentage of stand being killed.

(xx) These data are not necessary unless one wants to compare the data from the different strips.

UNIT REMARKS

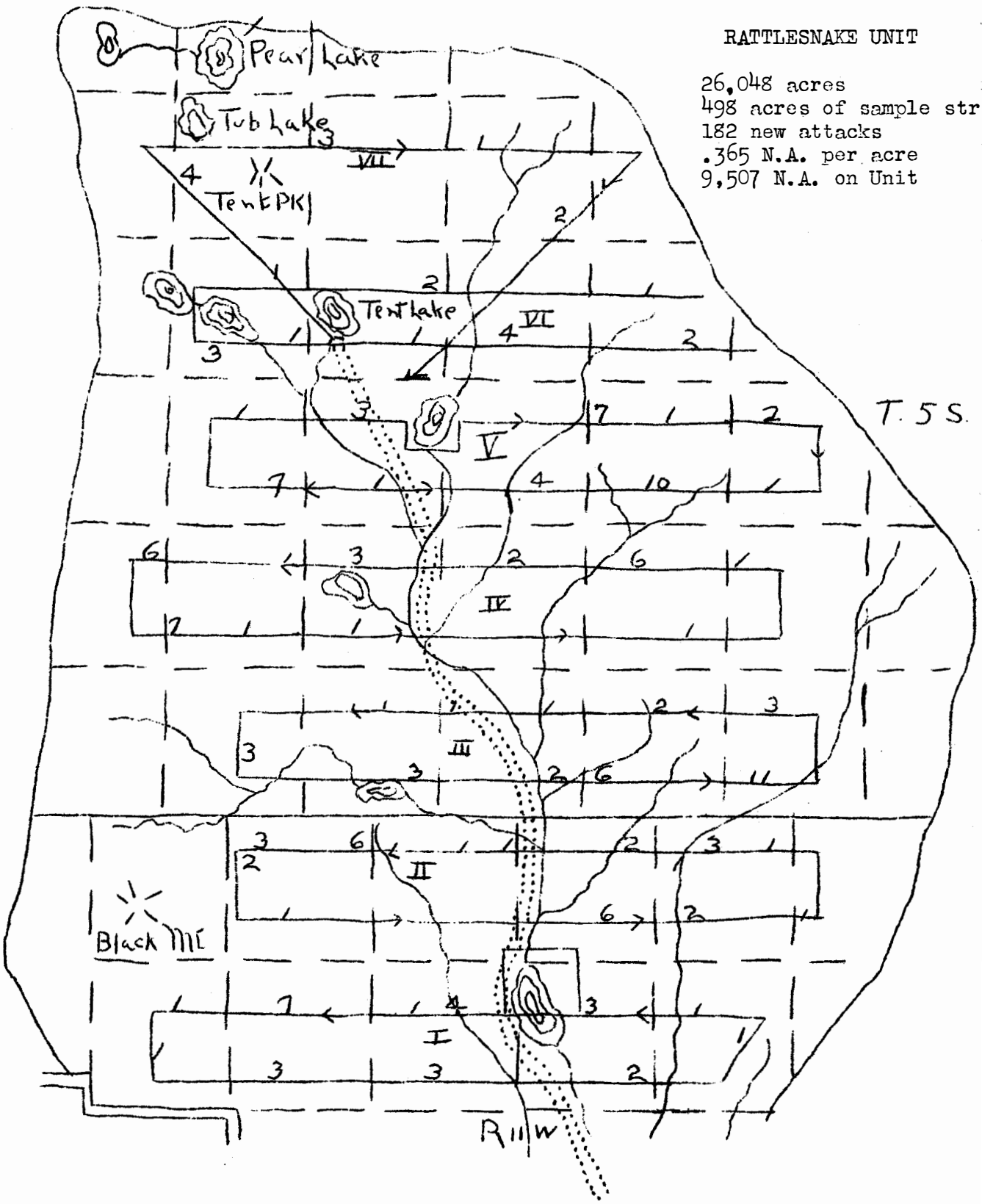
(Description of area to include terrain, timber types, age, and apparent vigor of timber stands, accessibility and values of timber at stake, character of attacks, location of infested trees, grouped or scattered, and all other details which will serve to depict the situation under consideration.)

The Rattlesnake unit is an accessible area of fairly easy terrain. Drainage contains a heavy stocking of mature lodgepole pine, averaging approximately 11 to 12 inches in diameter, with some scattered Douglas fir. Trees are clean boled and of a size suitable for ties.

The infestation is rather evenly distributed throughout the area, though it is somewhat lighter in the upper portion of the drainage. Most of the trees harbor heavy attacks, with normal brood. The attacks seem to extend to a height of 30 feet or more, which would indicate an aggressive infestation. Though there are a number of red tops in the area, it is evident that there has been an increase of several hundred percent over last year's infestation. Infested trees occur singly and in small groups.

(Sgd.) Henry Smith
Chief of Party

PORTION OF PROJECT MAP SHOWING PLOTTED STRIPS WITH APPROXIMATE LOCATION OF INFESTED TREES RECORDED



Establish Control Units.

The data should be recorded and worked up by convenient control units such as are now established on most of the forests which have conducted control operations for a few years. The same units must be used for survey and control during the entire life of the project. These units should be such as are ordinarily worked from one camp as drainages or combination of small drainages but in terrain with little relief they may be by legal subdivisions. For scattered Black Hills beetle infestations, such as that on the Ashley, units as large as whole drainages may be satisfactory.

Insect Survey Report.

The insect survey report should reach the Regional Office as soon as possible after the completion of the survey and should be in not later than the annual report on insect infestations (October 15). It should be summarized on a form like that on page 123 to show the essential features for ready reference.

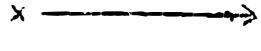
The narrative section should cover concisely for each unit the essential features such as character of timber, topography, character of beetle attacks, time of year control work should be done, history of epidemic, etc. It should also cover description of the survey itself such as method used, personnel, inclusive dates of survey, and cost.

Map Accompanying Insect Survey Report.

Only one copy of map mentioned in (6), page 108 need be sent the Regional Office as photostats will be made to supply the additional copies needed.

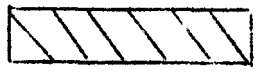
Use the following legend:

Unit boundary (show number or name of unit conspicuously within unit boundary)



Traverse line - arrow indicates direction of travel

Boundary of area covered - no insects found or endemic



Areas recommended for treatment

N.A. - 80 Estimated number of new attacks

. - 2 Number of new attacks found along traverse (dot shows location; figure shows number in group)

A 1/2" to the mile scale is large enough for this map and in many cases the 1/4" base map will suffice. One inch to the mile enlargements of the base map are good where it is necessary to show only a small area but it is desirable to show the entire job on as few maps as practicable.

Place all unit names and numbers in conspicuous places and make them large enough so they may be reduced in reproduction. Use opaque ink or dense crayon. High class draftsmanship is not necessary but clarity must be had.

When the cruise is made by sections the estimate for each section may be shown if desired but the control unit figure is the one most used and it is usually sufficient to show the unit figure, leaving the density of the attacks along the survey traverse to indicate the location of the principal epidemic centers.

In making up the map the following colors may be used where it is not desirable to use black ink: blue, red, violet, pink, brown show up well on a blue line print when photostated with color screen. On a black line map yellow, orange, red, pink and brown show up well. With any of these colors the line should be made as dense as possible. All of these colors photostat the same color (white) so that it is not practical to show distinctions by color alone.

INSECT CONTROL SURVEY REPORT

Units	Approx. Type Area	Strip Total Chains	Run-in Type C	Out of Type C	Strip Multi-plier	N. A. on Strip	R. T. on Strip	Total N. A.	Total R. T.	N.A. per 10 acres (year)	N.A. per 10 acres (year)	REMARKS
Totals												

Notes: Run in type - chains plus out of type - chains equals strip total - chains.
To obtain strip multiplier divide type area by acres in strip. Acres in strip is 1/10 of chains run in type (strip being one chain wide). 10 sq.ch. equals 1 acre.

N.A. on strip - this year's attacks "new attacks" harboring broods.
R.T. on strip - red topped trees on strip.
Total N.A. - total for the unit.
Total R.T. - found by multiplying N.A. or R.T. on strip by strip multiplier.

N.A. per 10 acres (year - 1937) - total N.A. divided by 1/10 the type area. For example, 420 N.A. on 2,100 acres of type equals 2 N.A. per 10 acres.

N.A. per 10 acres (year - 1936) - total R.T. (1937) divided by 1/10 the type area.

SPOTTING

Treatment of Attacks.

As a matter of ready reference there is included herewith a copy of "Instructions for Spotters in Bark Beetle Control Projects" prepared by Mr. James C. Evenden which is applicable when spotting is conducted in advance of actual control work. This is a procedure which might be described as 100% survey, supplemented by marking attacked trees and mapping their locations. The instructions have been prepared with particular application to mountain pine beetles in lodgepole pine but the principles involved will apply more generally.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

INSTRUCTIONS FOR SPOTTERS IN BARK BEETLE CONTROL PROJECTS

- - - - -

James C. Evenden
Senior Entomologist

The spotting of infested trees is the first and most important step in all bark beetle control projects. Success in this operation consists in locating, marking, and mapping all infested trees for subsequent relocation and treatment. The fundamental principles of spotting are set forth in the following paragraphs, but the solution of specific problems which may be encountered in performing this task must be left to the judgment of the chief spotters.

Although the importance of efficient spotting can not be overemphasized, when funds are limited measures should be adopted which will assure the direction of control to areas where the greatest benefits will follow. Departures from the standardized practice of spotting should be made only after all phases of the situation have been carefully considered by the officers in charge.

Only by covering the entire area under consideration can spotting be made efficient. Portions of infestation units such as nonhost timber types or areas of reproduction may often be eliminated as not warranting inclusion within the area to be spotted, but such action must be preceded by a careful preliminary examination. Preliminary examination of so-called "bug-timber" areas may indicate existing conditions.

Spotting may be divided into the following two general classifications: (1) Spotting as an operation independent of treating, and (2) spotting and treating as a combined operation. Although the fundamental principles are the same, different techniques of operation are employed.

SPOTTING AS AN OPERATION INDEPENDENT OF TREATING

The organization of spotting crews will of necessity vary for different situations. The size of the crew and the width of the strip to be covered by each spotter must be adapted to the timber type, topography, and character of infestation. In dense lodgepole and white pine stands where a one-chain strip is all that one man can cover efficiently a six-man crew gives the most satisfactory results. The personnel is composed of a chief spotter, a compassman, and four spotters. The chief spotter is responsible for the administration and work of his crew. Compassmen are required to extend accurate lines, pace the distances traveled, construct maps showing the location of the trees marked for treatment, and maintain a consecutive record of all tree numbers used. Each spotter is responsible for locating and marking all infested trees on a strip one

chain in width on the side of andparallel to the course of the compassman. Although under some forest conditions the width of this strip may be increased, a one-chain strip permits a close examination of all trees with a minimum of side travel.

Infested trees are marked with white or yellow cloth or card tags fastened to the tree with a tack in each upper corner. The data placed upon this tag will vary for different projects, depending upon the information desired, but will always include the tree number, crew symbol, and spotter's initials. Each spotter will carry a supply of tags on which he will have previously placed the crew symbol near the top and his initials in the lower right-hand corner. In addition to the tag the opposite side of the tree is blazed and marked with the tree number, which facilitates relocation in case the tag is destroyed. Lumberman's crayon is used for marking tags and trees.

When an infested tree is located, the spotter stops the progress of the crew, obtains a number from the compassman, and places it upon the tag. When groups of trees are found to be infested, the entire crew assists in marking all trees within the group, even though the infested trees extend into the next strip. When the group is marked the entire crew returns to the point on the line where the advance was halted. The crew then moves in formation through the group of infested trees, marking and recording any that have been missed.

Spotting crews are formed with the compassman in the center and two spotters on each side. The compassman serves as a guide to the inside spotters whereas the outside men are guided by the inside spotters and also by the compassman if he can be seen. Advancing formations should always be wedge shaped, as proper positions are more easily maintained and strips more thoroughly covered when the spotters are a trifle in the rear of the guide. The spotter who was on the outside course should be on the inside during the return trip on the adjoining strip, as he is familiar with the boundaries of his strip and will leave no ground uncovered. Compassmen will construct copies of the spotters' maps for each of the treating crew foreman and for the camp manager or office. These maps must be kept up to date, with each day's data being added to all copies. The spotter covering the outside strip will find it to his advantage to observe rather closely the character of his strip so that it can be identified on the return trip. The chief spotter's position is behind the compassman, where by working from side to side he checks crew alignment and positions, assists in the marking of trees, and sees that no infested trees are missed.

The organization of a three-man crew is apparent. Here the chief spotter, who is usually the compassman, assumes the duties of that position in addition to the responsibilities of a crew leader. As compassman he is between his two spotters, where supervision can be given to their work. Though at times it may seem advisable to

have the chief spotter cover a strip instead of acting as compassman, this practice should be avoided, as practically all of his time is required to fulfill his task of spotting, with no opportunity being afforded for crew supervision.

Spotting crews operate by traversing a section, or block of timber, through which parallel lines are projected on definite compass bearings. The speed of the compassman must be adjusted to the efficient operation of his crew. Under no circumstances should spotters advance ahead of the compassman. Trails, roads, or ridges can be used as base lines in unsurveyed territory. Even in surveyed territory it may be advantageous to use a natural or artificial base line or to establish one in a desired location. Where strips cross main trails or roads a tag showing the number of the strip should be fastened to a convenient tree or bush. These marks will be of material assistance to crew foremen in relocating the marked trees.

As the operation of a spotting crew can be adapted to meet all forest conditions, it is not necessary to cover a lot of open or nonhost timber areas. In small blocks or strips of timber each small area or a group of two or three areas can be worked independently. Under all circumstances the spotting strip should start from some known point, such as a bridge, gate, or trail crossing, to facilitate map construction.

In working narrow strips of timber, which are often encountered in lodgepole pine areas, spotting crews may be more efficiently maneuvered without the running of a compass line. Without a compassman the crew formation is changed so that the guide is the inside spotter traveling by the side of the previously run course. On the first course the guide usually follows the edge of the timber or some other line. If the guide is to the right, then each spotter conforms to the course being followed by keeping the proper distance from the man to his immediate right. A better alignment is maintained if the spotters are echeloned to the rear. To accomplish this formation each man should walk a few paces to the rear of the spotter who is acting as his guide. When two or more strips are necessary to cover one of these areas, it is essential that the outside strip be so marked that it can be followed on the return trip. Though trees can be blazed as markers, the quickest and most satisfactory method is to use half pages of old magazines, which are stuck on limbs and bushes. Although the compass may be abandoned, with most areas it will be necessary to pace the distance traveled and to construct spotter's maps. These maps are essential in the relocation of the marked trees.

Areas may be encountered where the infestation is of such density that it may be advantageous to treat large groups of infested trees before the area is spotted. This procedure reduces the time spent by spotting crews in tagging large numbers of trees. In the execution of this plan the procedure of operation will need to be adapted to meet the situations encountered. One man is usually assigned the task of marking such large groups, but regardless of the procedure followed adequate records must be maintained. Situations may occur where the greatest benefits would be derived by the abandonment of actual spotting and the entire allotment spent in treating the trees.

SPOTTING AND TREATING AS A COMBINED OPERATION

The standard methods of spotting and treating may be combined into one operation. As the combined project eliminates the necessity of relocating marked trees, pacing and mapping as employed in an independent spotting operation can also be eliminated. With such projects the crew organization as well as the technique of operation will vary to meet different situations. Large areas may be covered in the same manner as described for independent spotting. Compassmen may be used as crew guides, or the method described for the spotting of small areas will often be satisfactory. When no compassman is used the outside strip must be plainly marked so that it can be easily identified upon the return trip.

The organization most commonly used for combined spotting and treating has been a seven-man crew consisting of a foreman, five spotters and treaters, and a packer who follows with the treating equipment on pack horses. The spotters are deployed in echelon behind the guide spotter, with the crew foreman working behind the crew in the same manner as a chief spotter. The outside man marks the extreme outside of his strip with paper in such a manner that he can return on a strip parallel to it. When infested trees are located the treating equipment is brought up, the trees are treated, all members of the crew having specific duties to perform, and progress is resumed. Though this organization is satisfactory for small blocks or long, narrow strips of timber, in large areas where the strips are a mile or more long the use of a compassman as a guide provides a more thorough coverage.

IDENTIFICATION OF INFESTED TREES

Newly attacked trees are recognized by small exudations of pitch from holes made in the bark by the beetles (pitch tubes) or by boring dust at the bases of trees or on flakes of bark. With extremely heavy attacks pitch tubes are very small and not always visible and are sometimes entirely absent. They are never present in Douglas fir. When trees are lightly attacked the flow of pitch is so strong that the beetles are often washed from their short galleries, which are seldom more than an inch in length. Large pitch tubes are usually, though not always, an indication of pitched-out attacks. Fresh woodpecker work is a true indication that there were and possibly still are insects beneath the bark. Although it is relatively simple to spot most infested trees, it is necessary to examine rather closely the basal portion of every susceptible tree for external evidence of attack. With white and ponderosa pine trees, which are attacked early in the season, there is some fading of the foliage late in the summer, which can be used as a guide in groups of infested trees. Trees are sometimes attacked on one side only and these are often missed by spotters. If the green side is attacked later in the season or during the following season, the succession of attacks often confuses spotters as to whether the tree should be marked for treatment. Such trees

should be marked if they contain broods of the primary bark beetle. Trees that have been killed often have a green, unattacked spot of a few square feet of bark surface left at the base. If this spot is attacked the following season, one will find live brood at the base of a red-top tree attacked two years previously. When these situations are encountered, the question will arise as to the need for marking the tree for treatment; however, by the time the spotter's examination has been completed the infested surface will usually be rather thoroughly treated. With the exception of limber and whitebark pine at high elevations, red-topped trees (trees attacked the previous season) should be disregarded by the spotters, as the importance of these basal attacks does not warrant the time which is devoted to them. When these two species of trees occur at elevations of 9,000 to 10,000 feet, two years are required for the broods of the mountain pine beetle to mature. This condition necessitates the examination of all red tops in order to determine the need for treatment.

Spotters will be called upon to separate attacks of secondary bark beetles from those of the primary bark beetles, or species being combatted. To do so each spotter must be familiar with the seasonal history and characteristic gallery pattern of the primary beetle. An important fact to remember is that egg galleries, or main channels, of Dendroctonus beetles are packed solid with boring dust, whereas those of most secondary beetles are open and free from frass.

Although instructions can be offered which will assist spotters in locating trees attacked by bark beetles, it is primarily a matter of judgment to determine whether they should be marked for treatment. It is necessary to remove a piece of bark from nearly every tree. If a tree was killed by the primary bark beetle and there is sufficient brood to warrant treatment, it should be marked. Bark beetle broods are found in all stages of development, i.e., eggs, larvae, pupae, and new adults. The old parent adults will be found in the ends of egg galleries. In most instances they will be dead, but in some cases may still be alive when the tree is examined. Prior to emergence the new adults range in color from light to dark brown or black.

CHECKING THE WORK OF SPOTTING CREWS

The work of spotting crews should be checked at regular intervals by a well-trained spotter if accurate results are to be obtained. Check spotters run a meandering strip behind the spotting crew, counting the number of trees marked for treatment as well as those which have been missed. The percentage of infested trees that have been marked indicates the efficiency of the spotting crew.

EQUIPMENT AND REPORTS

Spotting Equipment (Six-man Crew).

1 Standard staff compass + staff
2 Tally registers

1 Tatum holder, 8 x 10 for map sheets
5 Light belt axes
Map sheets
Pencils
Tags
Tacks

Marking Tags.

Tags used in marking trees should be approximately 4 x 6 inches in size and of a color easily discernible in the forest. Tags are subsequently removed by the treating crew and given to the project manager as a check upon the trees treated.

Maps.

Forest Service map sheets (Form 878-a) are used in preparing spotters' maps. As the purpose of these maps is to serve in the relocation of marked trees, it is necessary that they be neatly and accurately prepared. Care and consideration by the mapper will save hours of unproductive labor by treating crews. In covering surveyed territory only one section or part thereof should be shown on each sheet.

Only essential data should be included, and minor details of topography, which in most instances are of no service, should be omitted. Trails, streams, ridges, peaks, fences, cabins, telephone lines, etc., are essential features which will assist treating crew foremen. The transparent sheets (Form 878-b) are convenient in copying maps in the field.

Spotter's Daily Record.

This form is used by chief spotters or compassmen to keep a record of tree numbers used each day. Consecutive numbers assigned to each crew will be placed on the form before the crew goes into the field. As numbers are given to spotters they are checked in the column marked "S" as spotted. This form is used by the camp manager, who checks under "T" as treated all tree numbers from the tags turned in by treating crew foremen, which provides a check of missed trees. The chief spotter begins his daily record sheet with the number following the last one used the previous day. Scale books having consecutive numbers already printed have been used in lieu of spotters' daily reports.

Spotter's Weekly Report.

This form is prepared by the chief spotter for the purpose of reporting the accomplishments of the week as well as information concerning the area to be spotted. This form should be filled out as thoroughly as possible since the information it contains will aid in the final plans for the project.

SPOTTER'S DAILY RECORD

Project Area Beaverhead Unit Rattlesnake Camp No. 3

Date Aug. 6, 1938 Spotter Olson T. 52 R. 11 Sec. 21

S	Tree No.	T	S	Tree No.	T	S	Tree No.	T	S	Tree No.	T
✓	673		✓	703			733				
✓	4		✓	4			4				
✓	5		✓	5			5				
✓	6		✓	6			6				
✓	7		✓	7			7				
✓	8		✓	8			8				
✓	9		✓	9			9				
✓	680		✓	710			740				
✓	1		✓	1			1				
✓	2		✓	2			2				
✓	3		✓	3			3				
✓	4		✓	4			4				
✓	5		✓	5			5				
✓	6		✓	6			6				
✓	7			7			7				
✓	8			8			8				
✓	9			9			9				
✓	690			720			750				
✓	1			1							
✓	2			2							
✓	3			3							
✓	4			4							
✓	5			5							
✓	6			6							
✓	7			7							
✓	8			8							
✓	9			9							
✓	700			730							
✓	1			1							
✓	2			2							

SPOTTER'S WEEKLY REPORT

Date August 11 Location of Camp Rattlesnake

Crew Symbol C Number of Men in Crew 5

Record of Trees Marked for Treatment

Date	Number of Trees	Sections or Area Worked	Remarks
Aug. 6	44	S ½ Sec. 21	Scattered trees
7	50	" "	" "
8	39	" "	Large (2) groups
9	28	Center Sec. 21	Scattered & groups
10	49	" "	" " "
11	51	N ½ Sec. 21	1 group 30 trees
12			

Remaining territory to be covered from present camp 3 sections or 1,500 acres

Number of days required to complete present camp area 23

Suggestions as to location of control camp in present area If spotters' camp was located prior to advent of treating, a different location for treating camps is often advisable.

Suggestions as to new location for spotters' camp Depends upon situations.

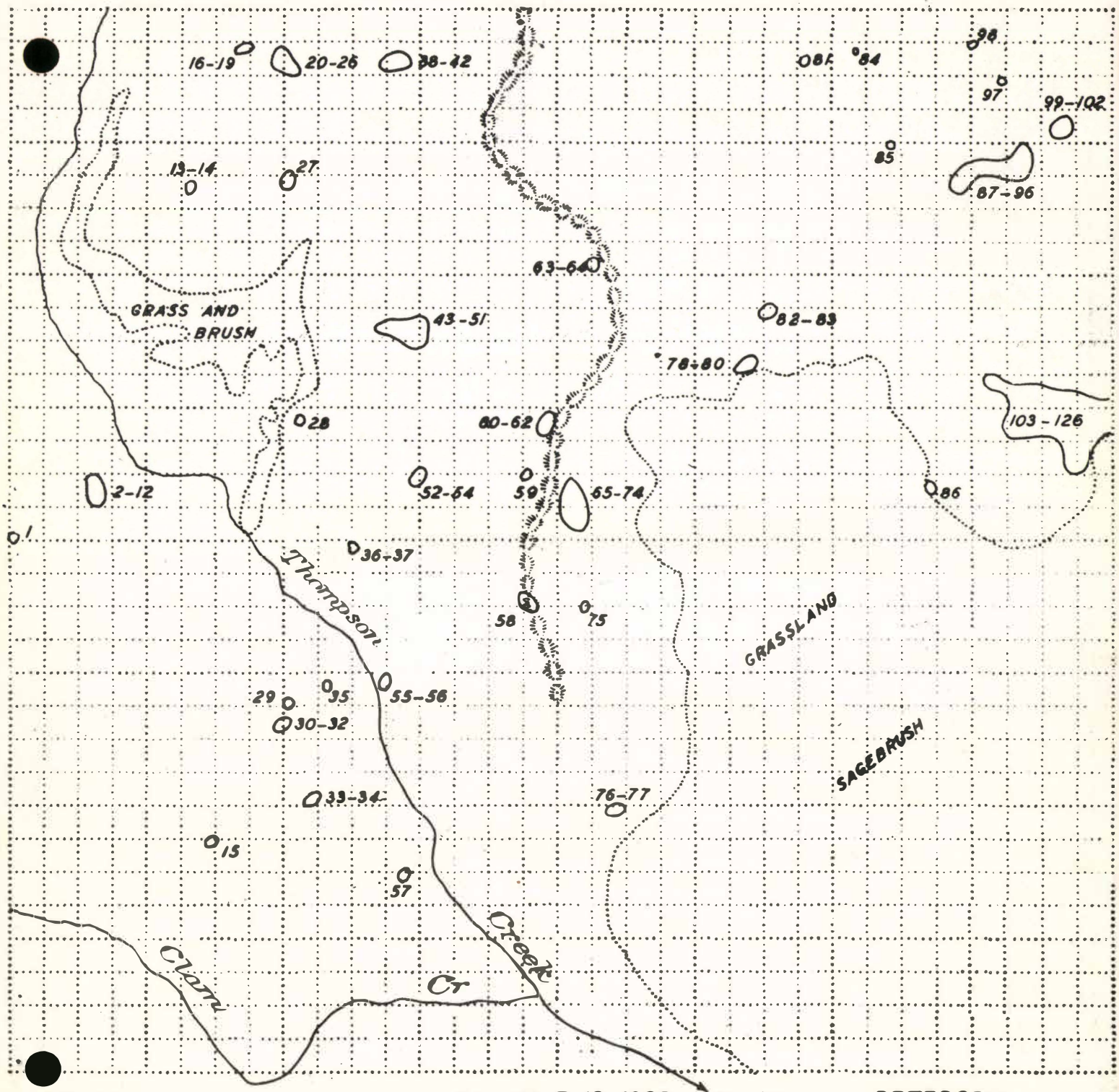
Remarks. (Suggestions, requirement, etc.)

(Signed) _____
Chief of Spotting Crew

UNITED STATES DEPARTMENT OF AGRICULTURE—FOREST SERVICE

..... Land District. Mag. Declin. ..... Area ..... Acres

..... (Case designation.), SEC. 30 (Subdivision and section.) T. 1 N. R. 15 W. Mer. Scale 8 inches = 1 mile



Field work by ....., Date JUNE 12, 1928, Platted by PETERSON

Remarks: NO. OF TREES 126

Approved ....., 19..., ...
(Approving officer.)

Form 878a
(Revised April, 1916)

B

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CONTROL

1. Time of Year for Control.

Control of bark beetle attacks may be done at any time of the year when the beetles are not in flight. Inasmuch as this varies according to the nature of the season as well as the species of beetle, it is necessary that first the beetle or beetles being treated for be positively identified and secondly, that the weather be closely watched.

2. Methods of Control.

There are several methods of control in use in the Region at the present time and new methods are being developed. The methods used vary according to the species of bark beetle, fire danger, species of tree attacked, and weather. These methods are as follows:

(a) Standing burning. The tree is sprayed with fuel oil and ignited.

(b) Falling, decking and burning. Trees are bucked up, decked and burned.

(c) Peeling. The tree is falled, bark peeled and exposed to the sun.

The first method is used largely on thin-barked and comparatively short trees such as lodgepole pine and limber pine. The method is rapid and economical where fire hazard and weather permit.

The second method is used on thick-barked trees where great heat is needed, and on tall trees impossible to spray the necessary height. It therefore is used largely on such species as ponderosa pine, Douglas fir and spruce. It also is resorted to for trees ordinarily sprayed and burned when fire danger becomes a factor.

The third method is used in summer when solar heat is sufficient, when fire hazard is great and for such beetles whose larvae or pupae will lie exposed when the bark is removed. Its use, therefore, is largely confined to treatment of Black Hills beetle in ponderosa pine.

In any treatment where burning is necessary, careful attention must be given to the hazards involved. It should be constantly borne in mind that the purpose of insect control is the saving of timber. It is obvious that carelessness with fire might easily result in heavier losses by fire than would have resulted from the infestation had no attempt been made at control. For this reason every precaution must be taken.

It sometimes is necessary in order that an epidemic be promptly and economically controlled, to do burning under conditions which might

quickly become dangerous. Such is usually the case in spring burning. Fuels may dry out rapidly and humidity drop dangerously on short notice. It is necessary that the man in charge not only recognize these conditions when they arrive but anticipate them sufficiently in advance so that not only is no further burning attempted but all hangovers from previous burning taken care of. Generally speaking, whenever the work is about to become more fire fighting than insect control, it is no longer justified.

The efficient insect control man, therefore, must take full advantage of favorable conditions so that a maximum amount of insect control is effected but must watch weather closely and take full precautions so that low control costs are not offset by high fire damage and suppression costs.

Treatment of Ponderosa Pine and Douglas Fir.

The crew organizations, reports, etc., are similar to that employed in treatment of lodgepole pine. The technique differs. The bark of lodgepole pine is thin enough so that intense heat applied from the outside for a few minutes will kill the larvae, pupae, etc., under the bark.

Heavy-barked trees such as ponderosa pine and Douglas fir are usually treated by cutting down the trees, placing the logs on skids and piling sufficient fuel around the logs to consume all the bark from the infested portion of the tree. Logs may be decked to reduce the amount of fuel needed for burning. In the case of the Black Hills beetle, whose larvae live between the wood and bark, peeling without burning is generally sufficient to kill the larvae. Care should be taken that the inner bark is well exposed to the sun, especially when the larvae are approaching the pupal stage. The larvae of the western and the southwestern pine beetles and the Douglas fir beetle live inside the bark of their respective hosts. The southwestern pine beetle seldom causes epidemics but is frequently associated with the western. If peeled the bark itself must be burned. Burning the logs is usually more readily accomplished than peeling and burning the bark. Control projects must be completed in general before April 15 depending on the season, due to emergence of adults around that time as well as danger in the use of fire.

INSECT CONTROL REPORT

On every insect control project a report will be prepared and transmitted to the Regional Forester as promptly as practicable. The Regional Forester desires four copies if they can be prepared conveniently in order to furnish one to the Chief and two to the Bureau of Entomology. However, only one copy of Form FM-I.C.-1 (atlas size insect control summary sheet) need be submitted as photostat copies will be made for Chief and Bureau of Entomology.

Report is required for every project worked even though no project funds are allotted.

Reports on fall control projects should reach the Regional Office not later than January 1 and reports on spring control projects not later than October 15.

Use the same control units as in the survey report.

Tabulation on Atlas Size Sheets.

Tabulations will be made on atlas size sheets for permanent record. Form FM-I.C.-1 may be secured on request from the Regional Office. The following headings which are those on Form FM-I.C.-1, were made up for use in bark beetle reports but can be used in all insect control projects.

1. Year.
2. Name of unit (use control unit names as in insect survey report).
3. Forest.
4. Duration of project (inclusive dates).
5. Tree species affected.
6. Insect responsible.
7. Method followed (burned standing with oil, felled and burned, felled and peeled, etc.).
8. Area treated (acres).
9. Number trees treated.
10. Percent of trees felled.
11. Expenditures from project funds (this should be approximately equal to your final allotment).
12. Expenditures from contributed time and expenses (include here also any sums made available from forest funds).
13. Total cost of project.
14. " " per tree.
15. " " " acre.
16. Gallons of oil used per tree.
17. Number of man days used.
18. Percent of reduction obtained. (This will have to be supplied after the next survey. It is figured on the number of trees treated on the unit. Thus, if 1,000 trees were treated and next survey shows 250, the reduction is 75%.)
19. Results. (This also will come in next annual report. State whether "controlled", "failure", "partial success", etc.)

(Note: Numbers correspond to numbered headings on atlas size Form FM-I.C.-1)

Detailed Cost Report.

Detailed costs will be kept as heretofore and reported in accordance with the form on page 137 of Region 4 Timber Management Handbook. The subsequent pages illustrate forms used by foremen and others as a basis for the final report.

Narrative Section.

The narrative section of the report should discuss individually each unit treated. Among the items to be covered are transportation, character of infestation, history of epidemic and control operations, character of timber, methods of control, number of camps, etc.

COSTS OF INSECT CONTROL PROJECT

_____ National Forest

Inclusive dates work carried on _____ _____
Forest Supervisor

Date this report made _____

Insect responsible _____

	Contributed time and expense	Project Funds	Total Cost
Salaries and wages, expenses forest officers			
Subsistence			
Equipment - purchase, repair, freight, etc.			
Oil			
Hauling, including Government trucks			
Horse hire			
Horse feed			
Miscellaneous			
TOTAL COST OF PROJECT			

No. man days contributed _____

No. man days paid from project funds _____

Total man days used _____

CAMP MANAGER'S WEEKLY TREATING REPORT

(Rev.March 1934)

_____ Forest

Locality _____ Unit _____ Camp _____

Production Record for Week Beginning _____, ending _____

Date	Day	Trees Treated: Standing	Trees Felled: and Burned	Crew: Man Days	Oil: Used	Horse: Days	Trees: Spotted	Spot Crew: Man Days
	S							
	M							
	T							
	W							
	T							
	F							
	S							
TOTALS								
Tot. Previously Reported								
Total to Date								

Meals Served	
Day	Number
S	
M	
T	
W	
T	
F	
S	
Total	
Prev. Reported	
Total to Date	

	This Week	Prev. Reported	Tot. to Date
A. Total effective man days treating			
B. Total effective man days spotting			
C. Total man days - All other			
D. Total man days temporary labor			
E. Total man days contributed			
Total horse days for camp			

REMARKS

(The sum of A, B, and C equals the sum of D and E. A includes foreman. B includes chief spotter. C includes camp manager, cook, flunky.)

_____
Camp Manager

CAMP MANAGER'S DAILY AND WEEKLY FINANCIAL REPORT

(Rev.March 1934)

Period Covered by Report
From _____ To _____

_____ Camp

_____ Forest
_____ Project

Dates	Day	Wages	Subsistence: Supplies	Purchase & Repair: Equipment	Cost of: Oil	Hauling	Horse Hire	Horse Feed	F.O. Travel: & Expense	Misc.	TOTAL
	S										
	M										
	T										
	W										
	T										
	F										
	S										
Tot. for Week											
" Prev.Rept.											
" to Date											

REMARKS .....

.....

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(Explain Misc. entries under "Remarks")

_____
Camp Manager

CREW FOREMAN'S DAILY REPORT

(Rev.March 1934)

_____ Forest

_____ Camp Locality_____ Unit_____

Date_____ Sections Worked_____

Names of Crew	Hours Worked	Trees Treated Standing	Trees Felled and Treated

Total Trees Treated_____ No. Horse Days_____

Total Crew Man Days_____ Gallons Oil Used _____

Total Trees per Man Day_____ Man Days Cont. Time_____

REMARKS_____

_____

_____

_____

("Total Crew Man Days" includes every man on crew - foreman, laborers, packers and forest officers)

_____

Crew Foreman